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An investigation of landslide deformation using range flow motion constraint applied on LiDAR data

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In this study we investigate the application of range flow constraint in determining the three-dimensional velocity fields of a deforming landslide using high resolution digital terrain models acquired from LiDAR data. The application of range flow allows comprehensive and detailed analysis of the deformation characteristics in a dynamic landscape of the landslide. It provides displacement vectors that are calculated from the topography of each grid point and its immediate neighbors. Furthermore this method can detect motion at sub-grid level and digital terrain models at different resolutions acquired from different sensors at different epochs can be utilized. The subject area for the analysis is the Doren Landslide (Vorarlberg, Austria) that has been measured several times by Aerial and Terrestrial Laser Scanning.

The range flow constraint equation is based on the spatial and temporal derivatives of the 3D surface. This constraint is applied to a local neighborhood and solved in a least squares framework which gives the motion vectors of the landslide surface between the acquisition of consecutive laser scans. Furthermore, if the surface has changed considerably in between the acquisition of two laser scans (e.g. due to human activity), the algorithm has the potential to outline these areas without providing the displacement vectors.

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